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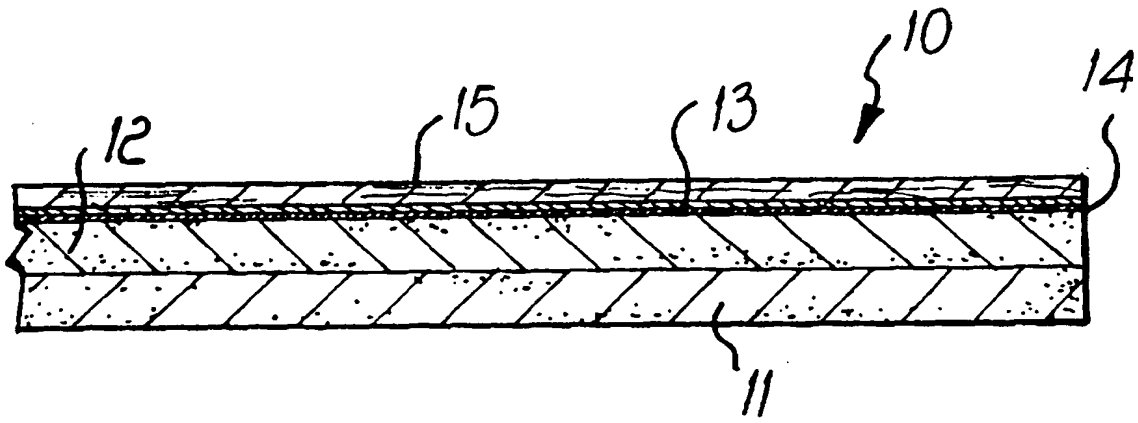

(57) Abstract

A panel for raised floors, comprising at least one layer (11, 12) based on cement and polymeric fibers, covered with at least one sheet of aluminum (13) coupled by an adhesive (14).

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PANEL FOR RAISED FLOORS

Technical Field

The present invention relates to a panel for raised floors and particularly to the structure of said panel.

Background Art

It is known that raised floors are substantially constituted by a metal frame that rests on the original floor and supports modular prefabricated panels of standard sizes, which are arranged side by side.

This forms an interspace, between the intrados of the panels and the original floor, which is advantageously used to place power and telephone cables, air-conditioning ducts, etcetera.

The advantage of raised floors resides in the fact that during their operating life, in case of malfunction or maintenance, the prefabricated panels can be easily removed to repair the facilities and then rested on the metal frame again.

Conveniently, the walking surface of the panels is formed by a covering made of quality material such as wood, carpeting, ceramics, stone, etcetera.

The materials used for the load-bearing body of the panels are the most disparate, including chipwood, plaster, cement, etcetera, optionally in combination (to improve the load-bearing capacity if the floor is subjected to flexural stresses caused by pedestrian traffic, the passage of trolleys or the weight of furniture and other static loads) with a steel reinforcing plate a few millimeters thick, the plan dimensions whereof match those of the panel.

Prefabricated panels for raised floors having a

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structure based on cement that is covered at the top at the walking surface have a severe drawback, during their operating life, due to the fact that they slowly but gradually warp, forming a concavity that is directed towards the extrados, i.e., upwards.

This interrupts the continuity among adjacent panels, the extrados edges whereof rise with respect to the central areas.

Eliminating the steel plate from the intrados theoretically eliminates the drawback of warping, but on the other hand it makes the panel unreliable as regards its load-bearing ability and consequently increases the risk of localized failure of the raised floor.

All this is worsened by brittle behavior, which is one of the characteristics of cement-based material.

If defects form at or near the intrados surface (in the form of microcracks that are invisible to the naked eye) during the production process of cement panels, these defects can in fact trigger the sudden brittle fracture of the panels, if the steel plate is not present, even if they are stressed for a very short time.

Disclosure of the Invention

A principal aim of the present invention is to eliminate the above-described drawback in panels for raised floors having a cement-based structure.

Within the scope of this aim, a consequent primary object is to provide a panel for raised floors which, despite not having a metal reinforcement plate on the intrados, is capable of withstanding sufficiently high bending stresses and of having a ductile behavior instead of

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a fragile one as regards bending fracture.

Another important object is to provide a panel for raised floors that does not undergo deformations over time, withstands a high concentrated load, and is not penetrated by pressurized water.

This aim, these objects, and others that will become apparent hereinafter are achieved by a panel for raised floors with a structure comprising at least one layer based on cement and polymeric fibers, covered with at least one sheet of aluminum coupled by means of adhesive.

Brief Description of the Drawings

Further characteristics and advantages of the invention will become apparent from the following detailed description of an embodiment thereof and of the steps of its production process, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a perspective view of a panel according to the invention;

figure 2 is a sectional enlarged-scale detail view of the panel of figure 1;

figure 3 is a chart that plots the deflection in mm as a function of time, measured in days, for a panel according to the invention, compared with the one of a panel according to the state of the art.

Ways of carrying out the Invention

A panel for raised floors according to the invention is generally designated by the reference numeral 10 and has a structure that is substantially composed of two separate layers 11 and 12, both of which are made of cement-like material and polymeric fibers, and is covered with an

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aluminum sheet 13 which is coupled by means of an adhesive 14.

The walking surface is formed by a layer 15 made of quality material, such as wood, carpeting, ceramics, stone, etcetera.

The panel 10 is the result of a production process that first of all provides for the production of the cement-based panel and then covers it.

As regards the production of the panel, first of all cement is mixed with additives, polymeric fibers, and water, so as to obtain a plastic paste.

A preferred composition of the mix includes:

-- Portland-type cement, pozzolanic cement, blast furnace cement, or even composite;

-- polymeric fibers, preferably of the polypropylene type (such as, for example, the commercial fibers known as Krenit by Addiment Italia and Retiflex by Retiflex S.p.A.), of the polyvinyl alcohol type (for example the commercial fibers known as Kuralon by Kuraray Co. Ltd.), or of the acrylonitrile type (such as for example the commercial fibers known as Ricem by Montedison), with a length that is substantially between 4 and 12 mm (preferably 6 mm) and a length/diameter ratio that is substantially between 200 and 1000 (preferably 350);

-- a water-reducing additive of the naphthalene, melaminic, or acrylic type (such as, for example, the commercial products known as Mapefluid by Mapei S.p.A.).

By way of example, for a panel the final measurements whereof are 60 x 60 x 3.4 cm, the following amounts can be given:

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-- cement: 10.71 kg

-- Retiflex polymeric fibers with a length of 6 mm and a diameter of 18 microns: 0.20 kg

-- Mapefluid additive: 0.10 kg

-- water: 1.5 kg.

At this point the mix is cast in a metallic mold that is higher than the final thickness of the panel, so as to obtain a panel with a uniform thickness of approximately 10-20 mm (for example 15 mm) as a consequence of the shaking of the mold.

The panel will ultimately constitute said layer 11 of the panel 10.

In a further step, cement is mixed with fibers, inert material, and water, so as to obtain the consistency of moist earth.

The materials are the same already described for the previous mix, with the addition of the inert material, which is chosen among the following preferred ones:

-- very fine powder (with a size of substantially less than 1 mm) constituted by ground rock or material recovered from the process of the subsequent gauging step (described hereinafter);

-- natural or artificial sand with a density substantially between 1 and 2.7 g/m^3, with a maximum size of substantially no more than 2 mm.

For a panel the final dimensions whereof are 60 x 60 x 3.4 cm, the amount of the ingredients in the second mix can be given, by way of example, as:

-- cement: 6.94 kg

- powder recovered from gauging: 2.31 kg

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-- light sand (expanded clay): 3.25 kg

-- Retiflex polymeric fibers (4 mm length, 18 micron diameter): 0.10 kg

-- water: 1.25 kg.

This mix, with the consistency of moist earth, is used to complete the filling of the mold, which already contains the first mix with plastic consistency, until the final thickness of approximately 40 mm is reached, thus forming layer 12 of the panel.

The content of the mold is then pressed (approximately 15 N/mm^2) so as to obtain a monolithic panel through the migration of the excess water that is present in the plastic layer towards the layer that has the consistency of moist earth.

As a consequence of this water migration, caused by pressing and by the dry state of upper layer 12, the plate, despite not having hardened yet, can be extracted and subjected to the subsequent setting step.

This is performed inside a chamber that is saturated with steam in order to facilitate hardening of the cement.

Moist setting can last a few days at room temperature and can be reduced to 12-16 hours if the temperature is raised to 40-80 degrees Celsius (for example 60 degrees Celsius).

After moist setting, the panel is left exposed to the air for up to approximately 7 days, so as to allow drying, which is usually accompanied by a deformation of the panel caused by differential shrinkage of the two layers 11 and 12, which becomes apparent as a warping of the item.

The subsequent step is the gauging of the panel to

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eliminate deformations.

This operation consists in performing the surface abrasion of the panel until a uniform thickness is achieved, obtaining the desired final thickness (for example, as mentioned, 34 mm).

The powdered material produced by abrasion can be recycled in the process itself as very fine inert material.

When gauging ends, the panel, in addition to having uniform and programmed dimensions, is covered with aluminum sheet 13 in order to make it capable of withstanding a high bending stress (at least 600 kg) applied to one of its extrados edges after placing the panel on four supports at the intrados corners.

The covering operation provides for a first step, in which a very thin layer of adhesive material based on polyurethane resin (for example the commercial product known as Adesilex) is applied to the gauged and set panel in an amount between 40 and 80 kg/m^2 (for example 60 kg/square meter).

A metallic sheet, preferably made of aluminum, with a thickness of 50 microns or less, is then applied to the panel treated with the adhesive resin.

As a consequence of the application of the aluminum sheet, the long-term behavior of the panel (and particularly its tendency to warp) is altered surprisingly.

In order to quantify the behavior of the cement panel according to the invention in comparison with normal commercially available cement panels, reference is made to figure 3, which plots the deflection "l" of the central region with respect to the edges of a panel (60 x 60 x 3.4

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cm) left exposed to the air for a few months.

The chart shows that the cement panel according to the invention (line 16) is considerably more stable and less deformable than a normal cement panel reinforced with a steel plate (line 17).

The technical performance of the panel according to the invention can be summarized by a concentrated load of more than 600 kg applied before fracture occurs, 0.5 mm deflection due to warping through exposure to air for two months, penetration of water under pressure (7 bar) lower than, or equal to, 1 mm.

In practice it has been observed that the intended aim and objects of the present invention have been achieved.

It has in fact been observed that the main drawback of raised floors made of cement panels, which is the slow but gradual warping of the panels and the consequent lack of continuity among adjacent panels once installed, has been fully eliminated.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept.

All the details may furthermore be replaced with other technically equivalent elements.

In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to requirements.

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CLAIMS

1. A panel for raised floors, having a structure comprising at least one layer based on cement and polymeric fibers, covered with at least one sheet of aluminum coupled by means of adhesive.

2. A panel according to claim 1, characterized in that it comprises, over said sheet of aluminum, at the walking surface, a layer of quality material such as wood, carpeting, ceramics, stone, or equivalent materials.

3. A panel according to claim 1, characterized in that it comprises two layers that are based on cement and polymeric fibers, a first layer being obtained with a mix that has a plastic consistency and a second layer being obtained with a mix that has the consistency of moist earth, the first and second layers being made into a monolithic unit by pressing.

4. A panel according to claim 3, characterized in that said first layer contains cement, polymeric fibers, water-reducing additive, and water.

5. A panel according to claim 3, characterized in that said second layer contains cement, natural and/or artificial sand, ground rock powder or powder recovered from the production process itself, polymeric fibers, and water.

6. A panel according to claim 4, characterized in that said polymeric fibers are based on polypropylene, polyvinyl alcohol, polyacrylonitrile, said water-reducing additive being based on a melaminic, naphthalene, or acrylic polymer.

7. A panel according to claim 3, characterized in that said first layer of cement mix having a plastic consistency

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is between 10 and 20 mm thick.

8. A panel according to claim 3, characterized in that said second layer of cement mix having the consistency of moist earth is between 20 and 30 mm thick.

9. A panel according to claim 1, characterized in that said aluminum sheet is between 10 and 50 microns thick.

10. A panel according to claim 1, characterized in that said adhesive is based on epoxy resin.

11. A method for producing a panel according to claim 1, consisting in:

-- mixing cement with additives, polymeric fibers, and water, so as to obtain said paste having a plastic consistency and cast it inside a mold;

-- mixing cement with fibers, inert material, and water to obtain said mix having the consistency of moist earth, and casting it in said mold over said mix having a plastic consistency;

-- subjecting the contents of the mold to pressing in order to obtain a monolithic panel;

-- drawing the mold and subjecting the item to setting;

-- gauging the panel by surface abrasion until a uniform thickness is obtained;

-- applying a very thin layer of adhesive onto the gauged panel;

-- applying said aluminum sheet.

12. A method according to claim 11, characterized in that pressing is performed with a pressure on the order of 15 N/mm^2.

13. A method according to claim 11, characterized in that said setting is performed inside a steam-saturated

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chamber.

14. A method according to claim 13, characterized in that said setting lasts for a few days at room temperature or 12 to 16 hours with a temperature raised to 40 to 80 degrees Celsius.

15. A method according to claim 11, characterized in that said moist setting is followed by drying of the panel in air for up to approximately seven days.

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AMENDED CLAIMS

[received by the International Bureau on 12 May 1997 (12.05.97); original claims 1-15 replaced by amended claims 1-14 (3 pages)]

1. A panel for raised floors, characterized in that it comprises two layers that are based on cement and polymeric fibers, a first layer being obtained with a mix having a plastic consistency and a second layer being obtained with a mix having the consistency of moist earth, the first and second layers being made into a monolithic unit by pressing and being covered with at least one sheet of aluminium coupled by means of adhesive.

2. A panel according to claim 1, characterized in that it comprises, over said sheet of aluminium, at the walking surface, a layer of quality material such as wood, carpeting, ceramics, stone, or equivalent materials.

3. A panel according to claim 1, characterized in that said first layer contains cement, polymeric fibers, water-reducing additive, and water.

4. A panel according to claim 1, characterized in that said second layer contains cement, natural and/or artificial sand, ground rock powder or powder recovered from the production process itself, polymeric fibers, and water.

5. A panel according to claim 3, characterized in that said polymeric fibers are based on polypropylene, polyvinyl alcohol, polyacrylonitrile, said water-reducing additive being based on a melaminic, naphthalene, or acrylic polymer.

6. A panel according to claim 1, characterized in that said first layer of cement mix having a plastic consistency is between 10 and 20 mm thick.

7. A panel according to claim 1, characterized in that said second layer of cement mix having the consistency of moist earth is between 20 and 30 mm thick.

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8. A panel according to claim 1, characterized in that said aluminium sheet is between 10 and 50 μm thick.

9. A panel according to claim 1, characterized in that said adhesive is based on epoxy resin.

10. A method for producing a panel according to claim 1, consisting in:

-- mixing cement with additives, polymeric fibers, and water, so as to obtain said paste having a plastic consistency and cast it inside a mold;

-- mixing cement with fibers, inert material, and water to obtain said mix having the consistency of moist earth, and casting it in said mold over said mix having a plastic consistency;

-- subjecting the contents of the mold to pressing in order to obtain a monolithic panel;

-- drawing the mold and subjecting the item to setting;

-- gauging the panel by surface abrasion until a uniform thickness is obtained;

-- applying a very thin layer of adhesive onto the gauged panel;

-- applying an aluminium sheet.

11. A method according to claim 10, characterized in that pressing is performed with a pressure on the order of 15 N/mm^2.

12. A method according to claim 10, characterized in that said setting is performed inside a steam-saturated chamber.

13. A method according to claim 12, characterized in that said setting lasts for a few days at room temperature or 12 to 16 hours with a temperature raised to 40 to 80

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degrees Celsius.

14. A method according to claim 10, characterized in that said moist setting is followed by drying of the panel in air for up to approximately seven days.

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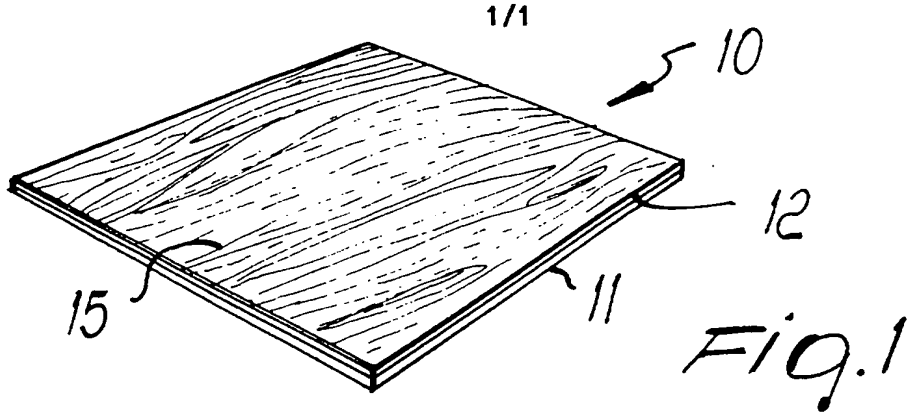

Fig.1

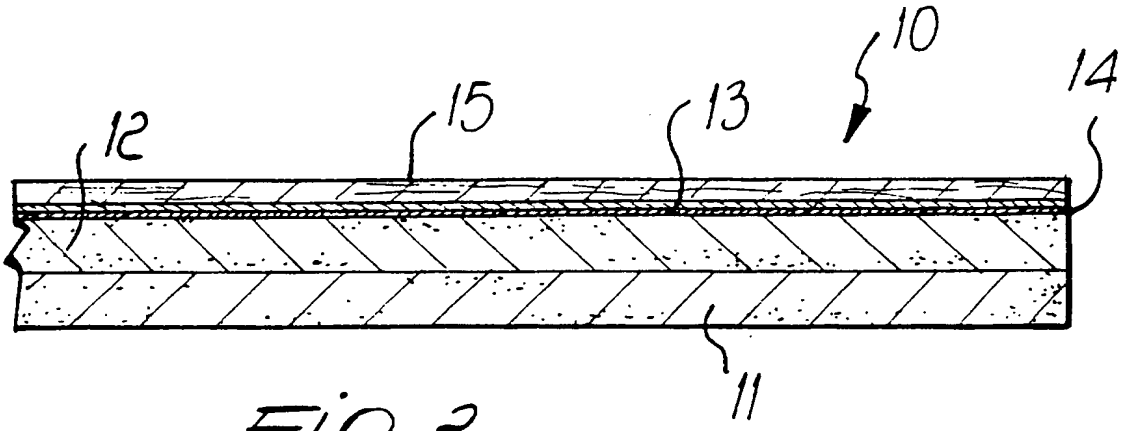

Fig.2

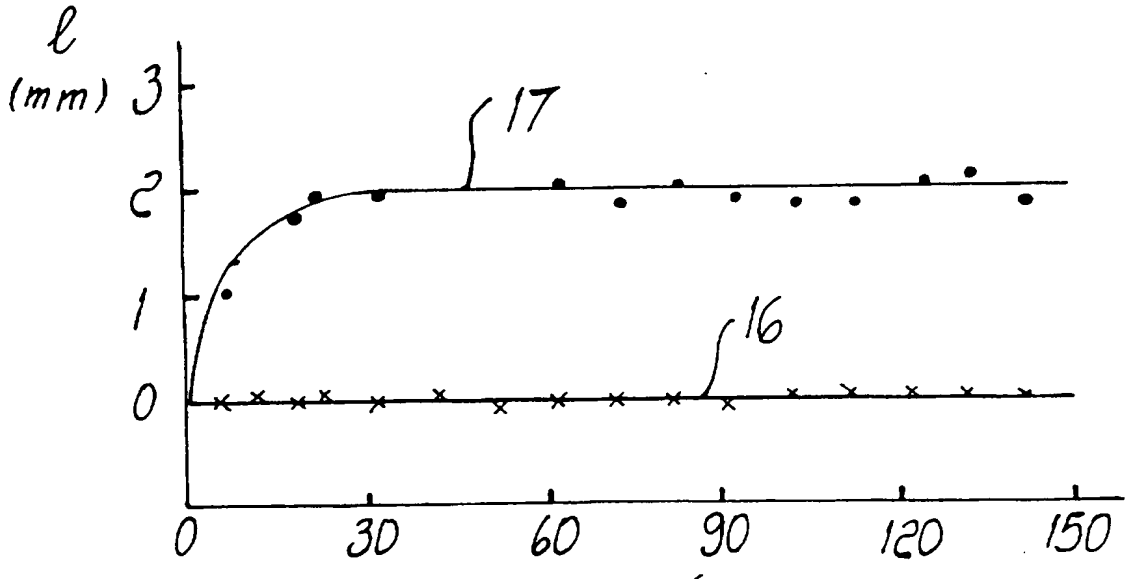

Fig.3

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 96/05224

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B32B13/02 B32B13/06 E04F15/024

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 477 533 A (PHILLIPS CECIL L) 16 October 1984 see claim 1 see column 1, line 41 - line 49 see column 3, line 29 - line 43 see column 4, line 3 - line 5 ---	1
A	US 4 441 293 A (MCQUEEN GEORGE ET AL) 10 April 1984 see column 1, line 30 - line 67 ---	1
A	US 4 113 913 A (SMILEY LEONARD H) 12 September 1978 see claims 1-4 see column 3, line 31 - line 54 --- -/--	1,3

[X] Further documents are listed in the continuation of box C.

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2

Date of the actual completion of the international search	Date of mailing of the international search report
5 March 1997	13. 03. 97
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Authorized officer Ibarrola Torres, O

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int tional Application No
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